CAISO Greenhouse Gas Market Design and Evolution for Diverse Regional GHG Policy

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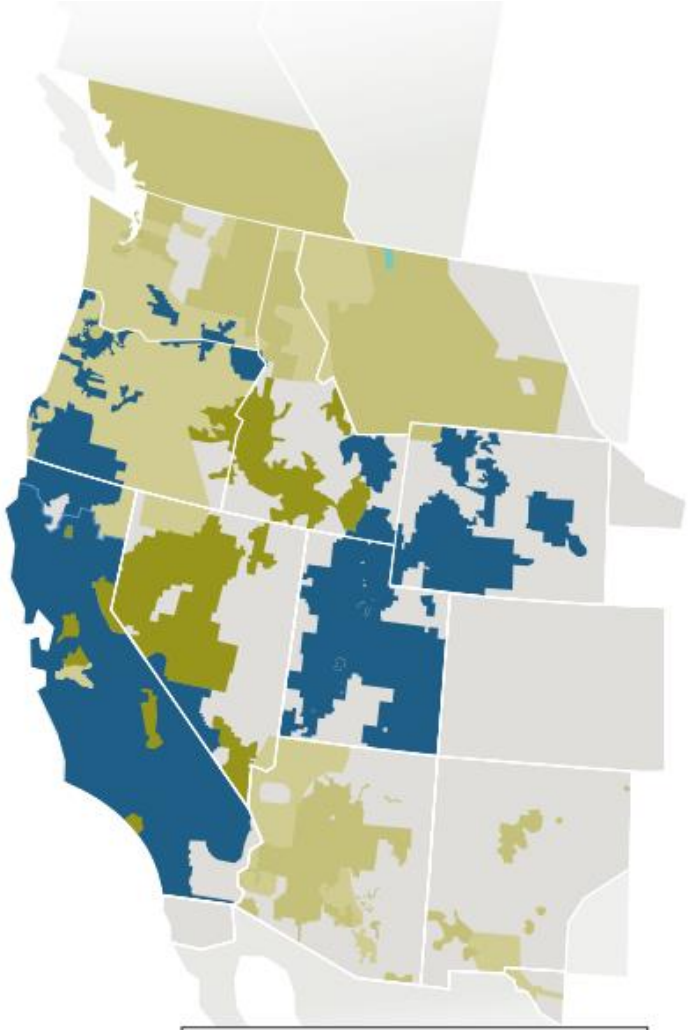
Evolving the Western Grid

- Market design to reflect GHG pricing policy has been in place in the Western Energy Imbalance Market (WEIM) since 2014, and will be extended in the Extended Day Ahead Market (EDAM)

- The stakeholder led GHG Coordination effort is exploring proposals to support diverse western states' GHG policies

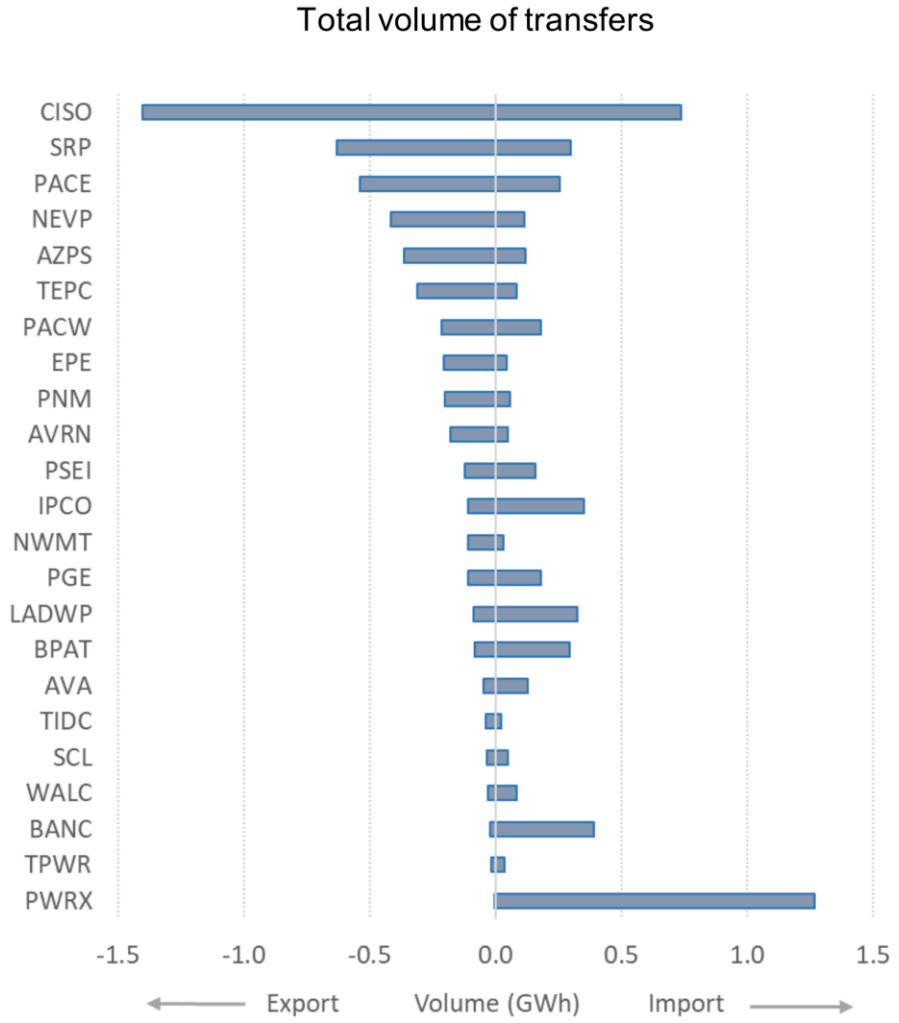


*These entities have publicly indicated a leaning towards EDAM as their preferred day-ahead market.

A regional market provides cost savings and efficiency by dispatching all resources within a single market

- Market participants bring resources to the table, and the market determines
  - How to meet demand at least-cost
  - How to set efficient prices

- Which resources are dispatched to serve load may be different in any given real-time interval than what a load serving entity offers



Source: Western Energy Imbalance Market Benefits and Market Update, Q4 2023.

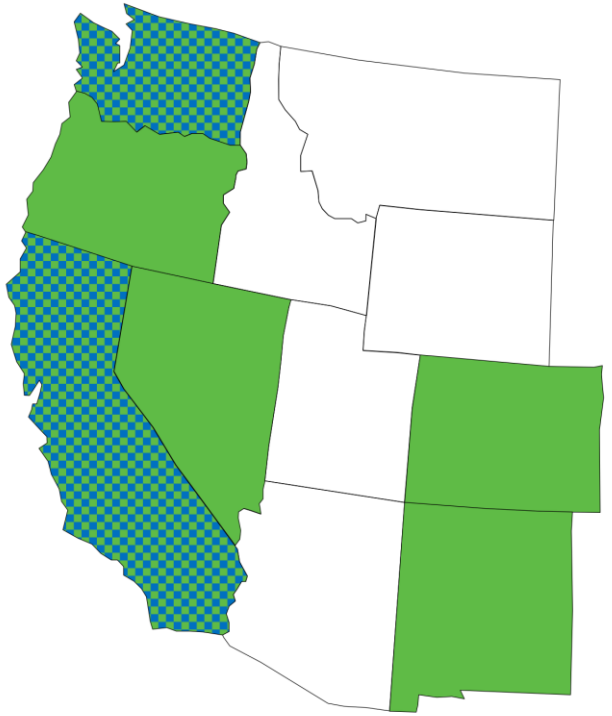
Diverse western states policy is supporting an energy transition

Price based policies (e.g. Cap-and-Trade)

- Increases the cost of producing energy from regulated, emitting resources
- Has implications for market efficiency

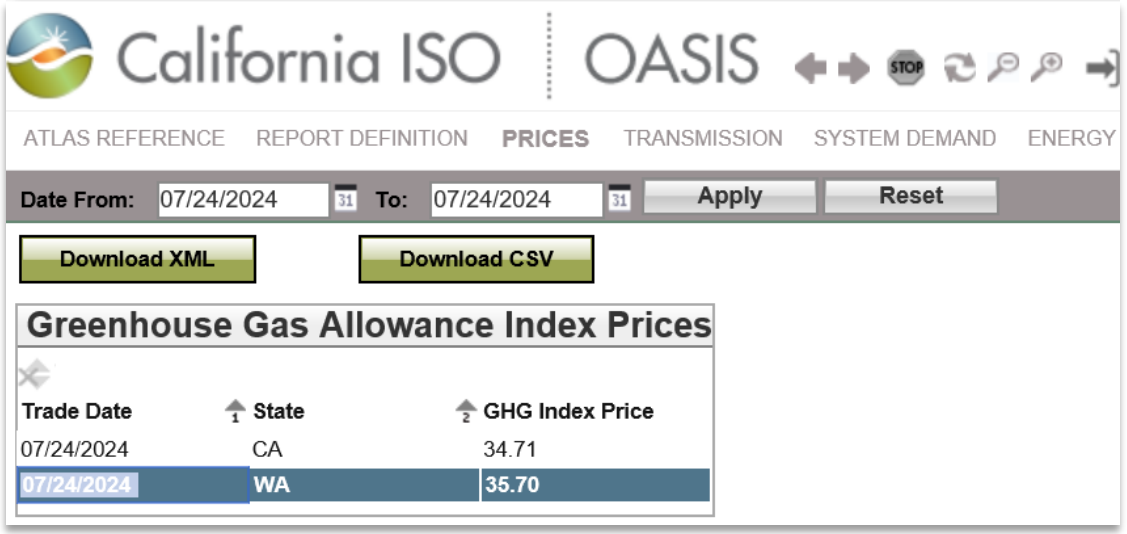
Non-price based policies (e.g. Mandatory Emissions Reduction Targets)

- Emissions associated with energy consumed may not exceed an annual target
- Unlike a pure portfolio-based policy, some states count emissions associated with market transfers
  - Stakeholder led efforts are considering in-market and after-the-fact accounting approaches



Source: Regulatory Assistance Project

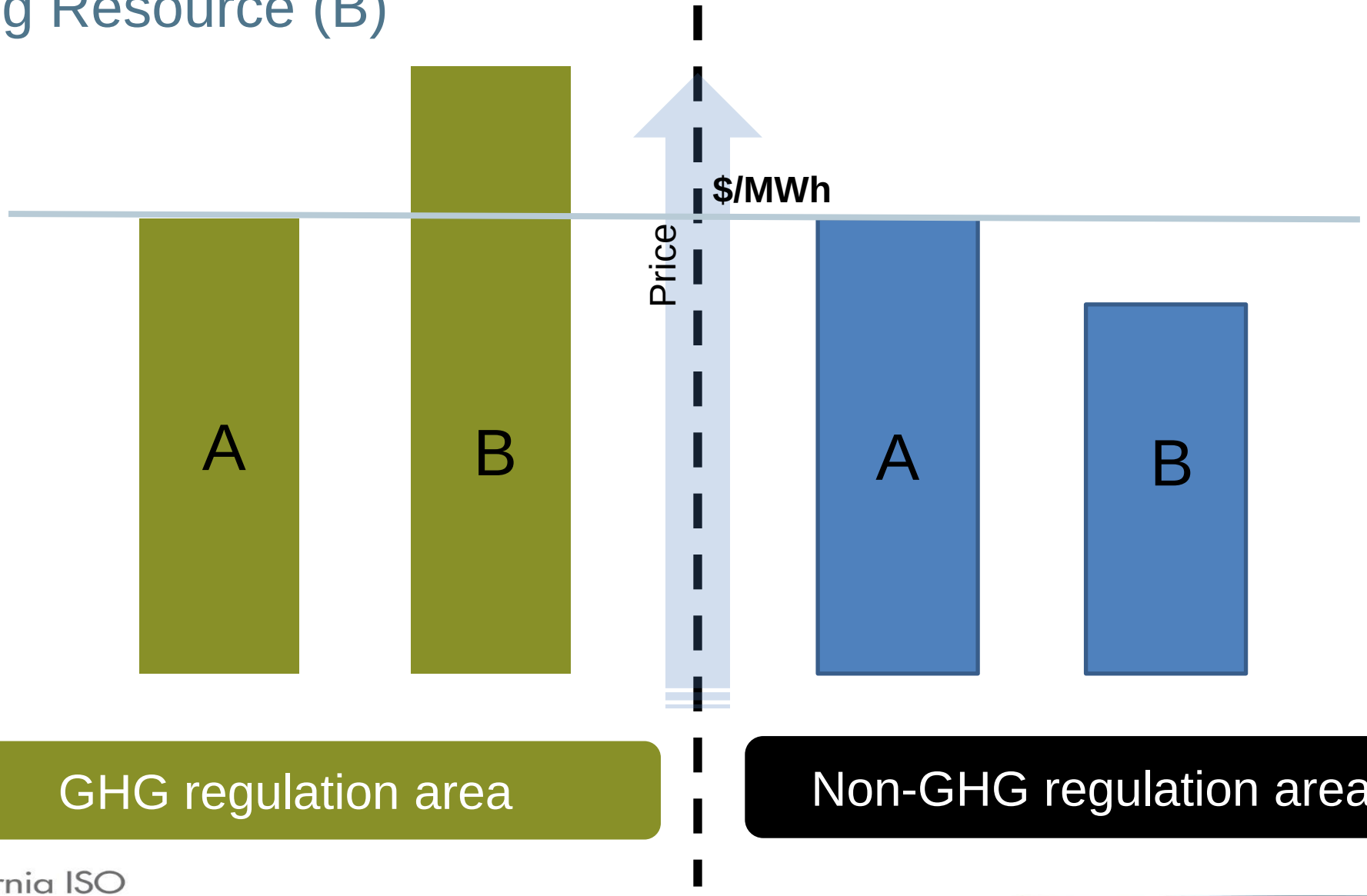
Price-based programs and market efficiency



CAISO Reports GHG allowance index prices for CA and WA, but the allowance index price is not a direct input of the optimization

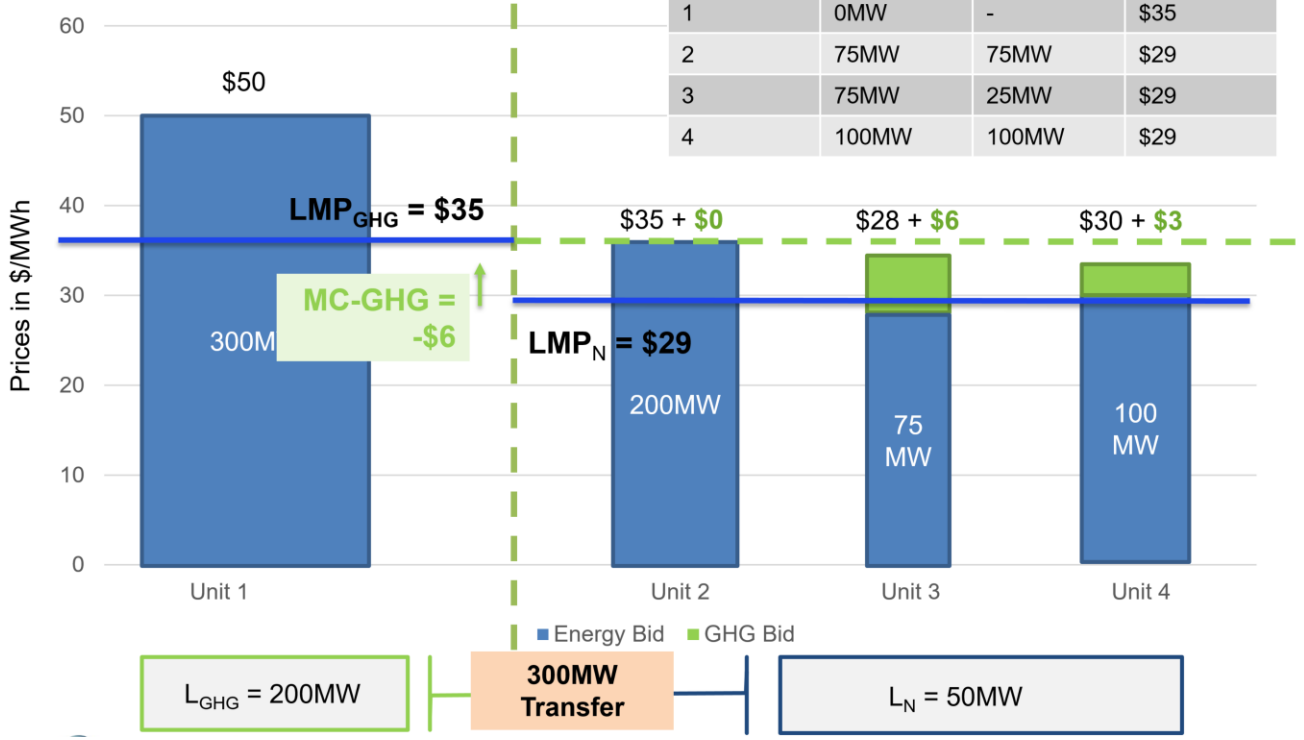
- State carbon policies can increase the marginal cost of resources in those states
- Different "jurisdictional preferences" for how GHG costs show up in the market can impact:
  - a least-cost solution, which may look different to different states
  - the relative value of one resource to another

Consider the same two resources: Clean Resource (A), and Emitting Resource (B)



GHG price formation accounts for separate GHG preferences

Unit	Dispatch	Export Allocation	LMP
1	0MW	-	$35
2	75MW	75MW	$29
3	75MW	25MW	$29
4	100MW	100MW	$29



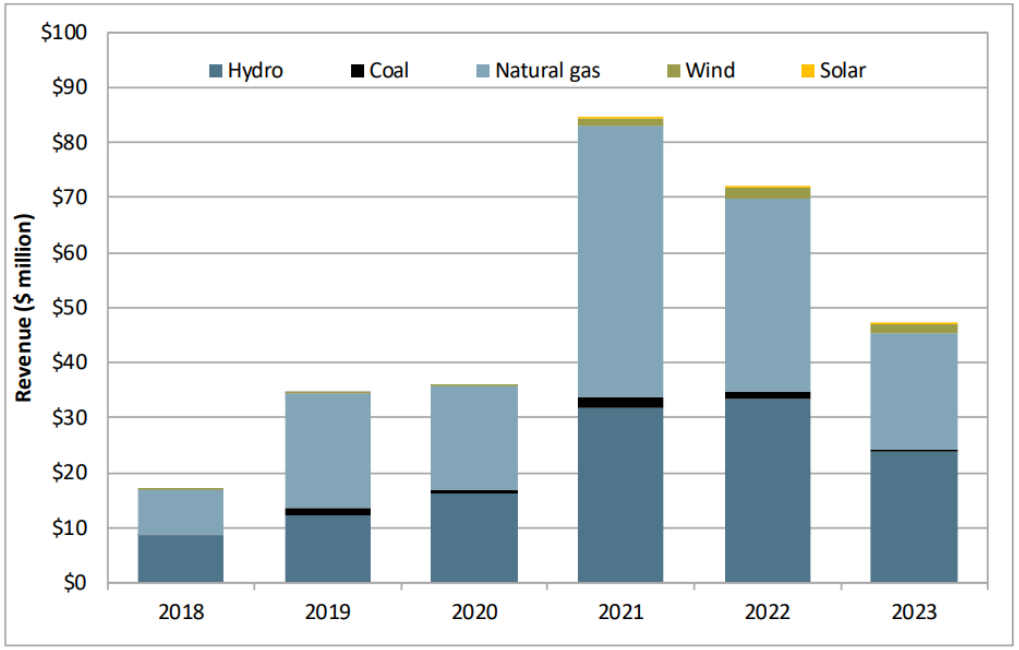
- The market uses resource-submitted GHG bid adders to co-optimize dispatch for the GHG area (left) and non-GHG area (right)
- This design minimizes the cost of one state's GHG policy on the rest of the market by assigning policy-related costs to regulated load (L_{GHG})

➢ To learn more, see GHG Coordination Evergreen Trainings on the California ISO youtube page

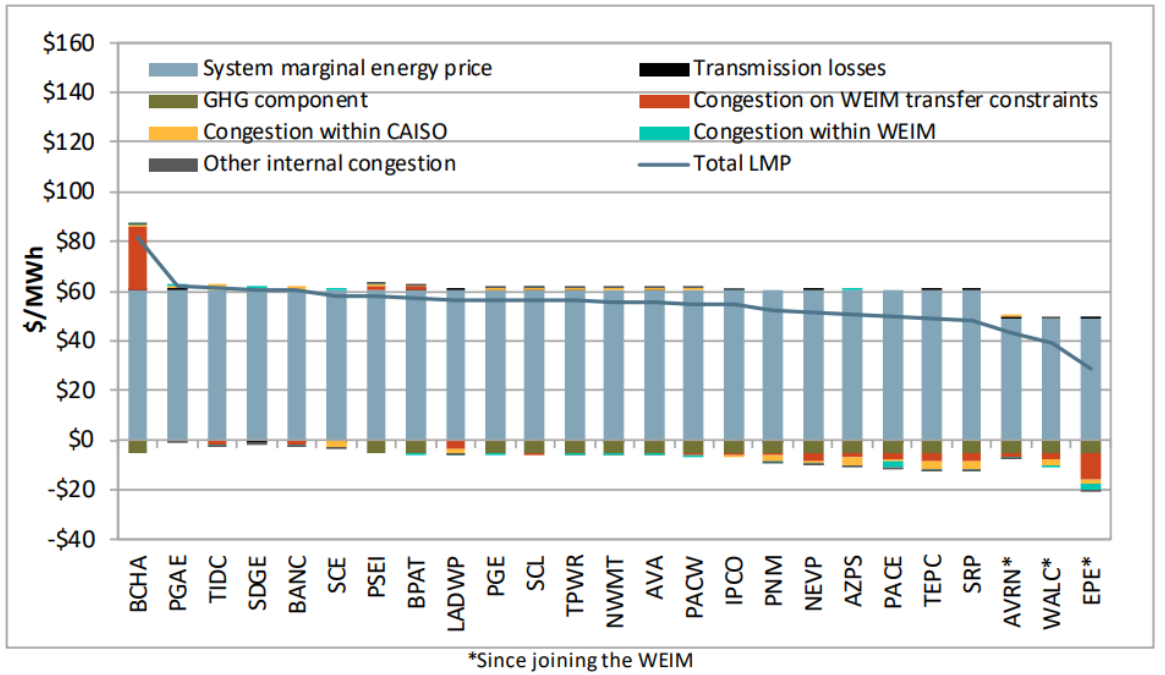
GHG Market Design in the WEIM and EDAM

- GHG attribution facilitates resource-specific compliance and reporting
- A component of LMPs, the marginal cost of GHG is the marginal cost of serving the GHG regulated area instead of the non-GHG area
- GHG Revenue, funded by the GHG area, covers compliance costs and and energy costs in excess of what the non-GHG area is willing to pay for
- EDAM extends today's framework so that resources can voluntarily elect to be committed and dispatched to serve load in multiple greenhouse gas regulated areas (Washington and California)

GHG in Market Results



Annual GHG revenue accruing to WEIM resources attributed to California by fuel type.



The impact, on average, of the GHG component on 15 minute prices in WEIM BAs

Source: Department of Market Monitoring 2023 Annual Report on Market Issues and Performance

Ongoing GHG refinement: GHG Coordination Working Groups

The GHG Coordination working group launched in 2023 in recognition of the need for greater collaboration to continue to advance GHG design. Three key areas of focus:

1. Design

- Educational review of GHG design in the WEIM and EDAM

2. Metrics

- Requests for additional GHG metrics and information to help support compliance

3. Beyond GHG Pricing

- Two approaches discussed:
  - An out-of-market GHG “Accounting and Reporting” approach; moving to policy development
  - An in-market GHG “Emission Constrained Dispatch” approach; needed by Oregon by 2030

CAISO publishes an Average Emissions Rate Report monthly

A	B	C	D	E	F	G	H	I	J	K	L
TRADE_	TRADE_HR	GEN_MWH	IMP_MWH	EXP_MWH	GEN_GHG	IMP_GHG	EXP_GHG	AVG_EM_RATE	ATTR_MWH	ATTR_GHG	ATTR_AVG_EM_
9/1/2024	1	76415	12352	-10059	25786	5287	-4305	0.34	1046	193	0.185
9/1/2024	2	72229	12280	-10098	24415	5256	-4322	0.341	621	149	0.24
9/1/2024	3	68823	12386	-10095	23325	5301	-4320	0.342	564	136	0.241
9/1/2024	4	66908	12882	-10637	22917	5514	-4553	0.345	440	111	0.252
9/1/2024	5	65924	12604	-10378	22559	5395	-4442	0.345	353	61	0.173
9/1/2024	6	65598	13950	-11699	22190	5970	-5007	0.341	286	31	0.108
9/1/2024	7	65802	14521	-12112	21738	6215	-5184	0.334	447	58	0.13
9/1/2024	8	66828	13147	-10979	18909	5627	-4699	0.288	286	22	0.077
9/1/2024	9	70557	11828	-10023	16841	5063	-4290	0.243	44	0	0
9/1/2024	10	73621	11801	-10065	16347	5051	-4308	0.227	0	0	0
9/1/2024	11	76670	11459	-9882	16881	4904	-4229	0.224	0	0	0
9/1/2024	12	80996	11296	-9941	17521	4835	-4255	0.22	0	0	0
9/1/2024	13	85478	12029	-10715	18523	5148	-4586	0.22	0	0	0
9/1/2024	14	91009	12267	-10903	20108	5250	-4667	0.224	0	0	0
9/1/2024	15	95907	13244	-11759	22103	5669	-5033	0.233	0	0	0
9/1/2024	16	101014	13109	-11725	23866	5611	-5018	0.239	0	0	0
9/1/2024	17	105644	13548	-12654	25471	5798	-5416	0.243	0	0	0
9/1/2024	18	106765	14456	-13392	27083	6187	-5732	0.255	141	0	0
9/1/2024	19	105546	15804	-14558	28158	6764	-6231	0.269	524	0	0

These reports are publically available at [Library | Average emissions rate reports - 2024 | California ISO (caiso.com)]

Accounting and Reporting Approach: out of market and after-the-fact

Stakeholder identified objectives: facilitate residual emissions rate calculation, prevent double counting

- Provide data to support entities subject to climate policies not based on a price of carbon
  - Allow entities to after-the-fact, outside of the market, account for the energy and emissions of their owned and contracted fleet as well as what they are long/short in the market relative to their load
  - Recognize the data supports both compliance and voluntary purposes

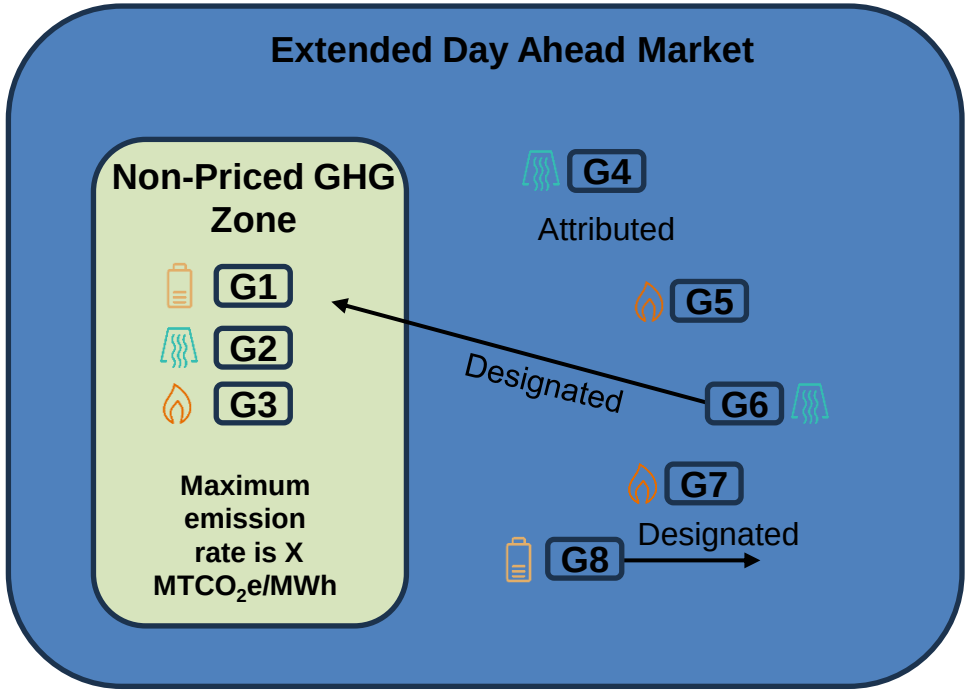
- Not impact market dispatch, emissions, or costs on other states

Accounting and Reporting Approach: stakeholder suggested formulation

On a 5 minute basis for a state, LSE or energy user, calculate:

	Dispatched Owned Resources
+	Dispatched Contracts for Purchase
	Total for owned/contracted
-	Attributed owned/contracted
	Total for owned/contracted - attributed
If Total > load	
-	*Energy @ LSE emissions rate*
If Total < load	
	Energy @ residual emissions rate
+	*(considerations for null power)*
	FINAL TOTAL

Emission Constrained Dispatch Approach



- Extends the CAISO's resource-specific approach with bid adders and attribution to a Non-Priced GHG Zone
- A maximum emissions rate for the dispatch interval is established by the Non-Priced GHG Zone
  - Does not need to be enabled in every interval
  - Includes reliability and cost off-ramps
- Optimization chooses which resources are attributed to GHG Reduction Zone
  - Lowest system cost while meeting maximum emission limit in GHG Reduction Zone
  - Attribution of external resources is voluntary
  - Requires the GHG Reduction Zone to offer generation that meets their maximum emissions rate
  - Designated resources are attributed to their designated load.
- Produces marginal energy and marginal GHG cost

Next Steps

- The GHG Coordination Working Group will continue to refine the Accounting and Reporting approach and GHG metrics for go-live monitoring

- Publication of a Fall Issue Paper on the Accounting and Reporting approach